Math Anxiety And How It Affects High School Students

Kathleen A. Murr, Walsh Jesuit High School <murrk@walshjesuit.org>

Kathleen has been working for the Educational Service Center of Cuyahoga County for fifteen years as a Remedial Mathematics Teacher at Walsh Jesuit High School in Cuyahoga Falls, Ohio. She works exclusively with students who are struggling in mathematics.

Introduction

I conducted this study while teaching in a private college-preparatory school, with an enrollment of 854 students from upper-middle class families. The population was 93 percent Caucasian, 3.6 percent Afro-American, 1.7 percent Asian, 0.5 percent Hispanic and 1.2 percent multi-racial. Students are accepted after a long process. It includes an entrance exam, formal application and essays written by former teachers and the students. All students are required to take four years of mathematics. As the remedial teacher for the past fifteen years, my work has focused on tutorial programs for students having difficulty with mathematics. My "core group" consists of students who had done poorly on the entrance exam or who were considered at-risk of failing by their classroom mathematics teacher. The members of the math department are dedicated and caring teachers who want students to succeed. Yet, it is a fact that we still had students who are struggling. This condition was given a name and a definition by Richard M. Suinn of Colorado State University and Frank C. Richardson of University of Texas in 1972. They described math anxiety as "feelings of tension and anxiety that interfere with the manipulation of numbers and the solving of mathematical problems in a wide variety of ordinary life and academic situations."

My concerns were the role that math anxiety played in the poor performance of these students, what promoted such feelings, and what teachers can do to lessen this anxiety.

Description of the Research Process

Various groups of students were surveyed regarding their definition of math anxiety, whether they have ever experienced it, who or what has influenced their feelings regarding mathematics and how they deal with stressful situations in their math classes. Students were asked to write reflections on homework assignments and quizzes. Grades were reviewed before and after this process. Adults in math-related professions were interviewed regarding their choices of professions, their definition of math anxiety, their impression of a strategy of written reflections in math classes and the importance of math in everyone's lives. Class discussions were held with my Core Group of at-risk students about how they learn best, what would reduce stress in math class and the purpose of math in their lives. Members of the math department were asked to share their thoughts about math anxiety and what strategies they find most successful in helping students to understand. Parents were questioned regarding their personal experiences with mathematics and the role they play in assisting their children with homework. Interviews were done with two students who exhibit definite signs of anxiety in the math classroom. The data were examined for trends in student responses, for improved grades after written reflections, for adult impressions regarding mathematics, and for suggestions to remove stress from the mathematics classroom.

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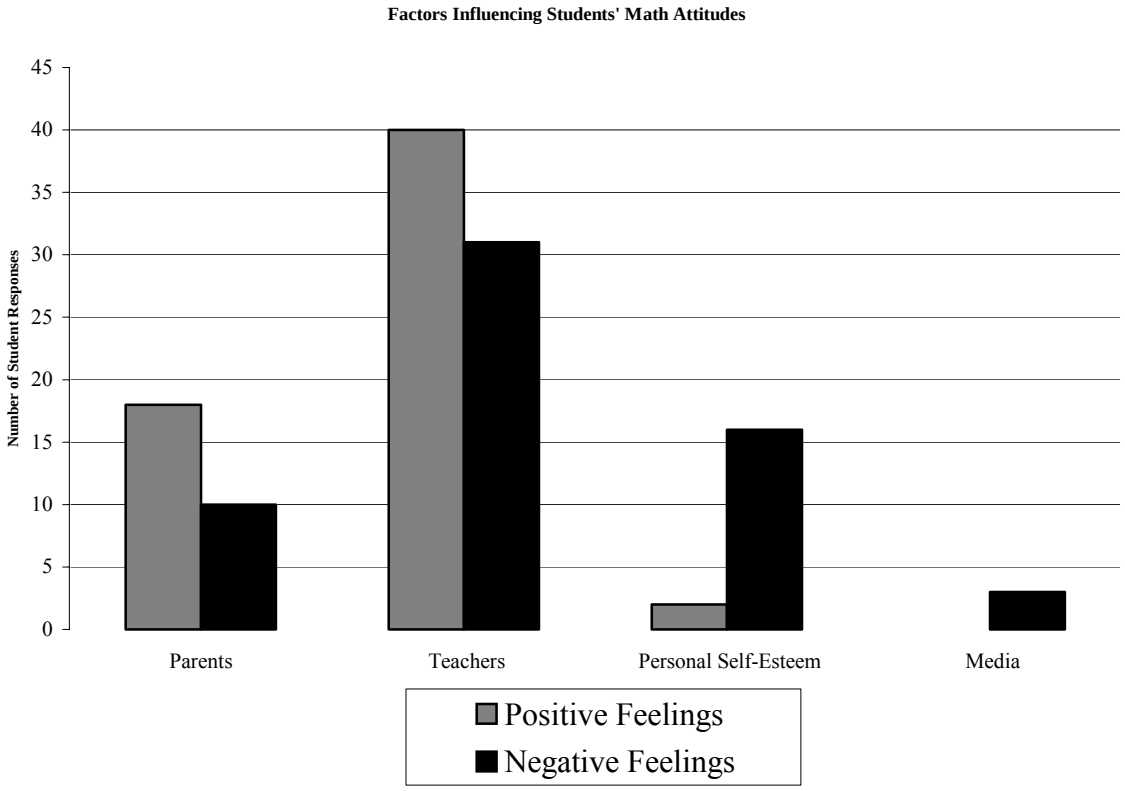
Analysis of the Data

One senior in College Algebra defined math anxiety as "being lost 90 percent of the time… ." When asked to define math anxiety, 92.6 percent of all 200 students and adults tended to describe it as a negative feeling associated mostly with performance on quizzes and tests. Emotions such as fear, nervousness, stress, frustration, and confusion were regularly mentioned in definitions. Unexpectedly, there was a small group who viewed math anxiety as a positive feeling related to doing well on tests and feeling good about the subject in general. These students, whose responses

made-up 7.4 percent of those surveyed regarding a definition, saw this anxiety as an excitement felt when dealing with challenging problems and acceptance of the work involved, a type of satisfaction that comes from knowing what to do. They described it as a motivator for achieving good grades. It is obvious however, that a majority of respondents to this survey viewed math anxiety as a negative factor, not caused by other subjects in the curriculum. Eighty percent said they have experienced these strong feelings at one time or another. The types of emotions mentioned can be controlled, just as fears of flying or heights can be addressed. Strategies can be taught and attitudes can perhaps be changed if those of us nearest these children recognize our impact on this anxiety.

Both adults and students surveyed pointed to certain people who influenced their attitudes toward mathematics. Of those surveyed, 33.7 percent attributed that attitude to a mathematics teacher. Parents were mentioned by 15 percent of those questioned as being a positive influence on their math attitude. Only 1.5 percent of students and adults said that their own positive self-esteem was helpful in building a good math attitude. Teachers were listed as the main influence in a negative attitude toward math by 26 percent of those responding. Parents were mentioned by 8 percent as the cause of a poor math attitude. Self-esteem was listed by 13.3 percent of those surveyed as a reason for their negative attitudes. This was an increase of 11.8 percent over the same factor producing positive attitudes. It appears that one's own impression of mathematical abilities is stronger in the negative rather than the positive vein. Another factor mentioned as a negative influence for 2.5 percent of the people was the media.



Teachers appear to have the greatest influence in either direction over students' attitudes. Not surprisingly, all of those adults working in math-related fields received positive encouragement from some family member. A majority of parents questioned felt that strong math abilities were gender-related, and 66 percent of them believed that children are born with strong mathematical abilities.

Student Recognized Problems

Students were asked what they perceived to be the major causes of heightened anxiety in the mathematics classroom. They expressed concern regarding:

- The fast pace of instruction and sparse explanations
- Minimal board work
- Use of word problems
- Lack of one-on-one work with the teacher
- Insufficient practice problems
- Few opportunities to ask questions
- Too little time for taking tests
- Lack of relevancy to their lives
- Fractions in general
- Lack of group work
- Restricted use of calculators
- Few hands-on activities

One cause of anxiety that was addressed in a separate question answered by all students was homework. All 120 current students were asked how they deal with homework difficulties. The most popular response by 43.3 percent of the students was, "I skip the question." The next most popular answer by 18.3 percent of the students was to copy the answers from the back of the book, if listed. Checking with a friend is used by 16.7 percent of the students when having difficulty with homework. Working to solve the problem and asking the teacher or parents were mentioned by less than 10 percent of the students. Most parents interviewed concurred that they did not help their children very much in high school. However, the majority mentioned that they would be willing to help if asked.

In an effort to help students avoid skipping problems that they don't understand, written reflections were examined as an alternative. Students were asked to give written explanations of three problems on each of their homework assignments during a two-week period. They were encouraged to explain each step and give a reason for it. Two quizzes were also given during this time. Students were subsequently asked to examine these quizzes and provide written explanations of where errors were made and what should have been done. They were given extra points for meaningful corrections. When asked later if they felt that the reflections improved their understanding of the materials, over 85 percent replied positively. Students appreciated a second chance, and one even mentioned that this process complimented her learning style. Of the 31 students then tested at the end of the chapter, 38.7 percent improved their grade by one to three points. Improvement of four to six points was experienced by 25.8 percent of the students, 12.9 percent had scores that decreased by one to five points, and 22.6 percent showed no improvement. All but three of the students did a good job describing their errors and the way to correct them.

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Adults surveyed who work in math-related fields other than education overwhelmingly stated they saw no value in written reflections but did see a great deal of value in multiple practice problems. However, one highly successful analyst in investment banking, valedictorian of her high school and college graduating classes, made the following statement about written reflections. "It often helps to write out the process of how to solve a problem. It aids in successfully approaching unfamiliar problems. I often wrote out lengthy study sheets for math classes which included a description of the problem and solving process for each problem type."

Mentioned often in the course of class discussions with students, interviews with adults, and survey responses was the general acknowledgement that mathematics is an important part of all of our lives. All parents, faculty, and other professionals expressed the importance of developing the ability to logically approach math-related problems in their personal and professional lives. As one said, "Math provides a unique way of thinking that is difficult to grasp initially but essential to develop for work in the professional world." When students were questioned on the importance of mathematics, only 5 percent felt that there was none for them. For the remainder of the group, regardless of their personal feelings about mathematics, they realized that math plays an important role in their lives. In some cases, this realization was listed as a source of anxiety. They fear that their poor math abilities will keep them from entering a career that is lucrative as well as interesting.

In the course of the data analysis, I have discovered two surprisingly prevalent comments. Teachers were ranked highest in the question about the strongest influence in lives, positive or negative, regarding mathematics. In addition, when students were asked how they dealt with difficult homework problems, a large number of them acknowledged that they just skip the problem.

Action Plan

Students themselves were asked what they believe could be done to lessen the anxiety in a mathematics classroom. The most popular suggestion targeted teacher behavior as the area to be improved. In addition, students expressed a need for:

- Increased board work
- More direct questions from the teacher
- Compliments that build their confidence
- Slower pace
- Patience and slower speaking on part of the instructor.

A few students actually acknowledged that if they studied more diligently their feelings of anxiety probably would decrease.

Anxiety and Homework

At the present time, it appears that students are unwilling to even attempt difficult types of homework problems. If they can't immediately proceed with familiar steps to a solution, the problem is considered too challenging and not within their realm of ability to solve. Rather than allowing students to skip these "unsolvable problems," perhaps teachers could point out a different approach by writing an analysis of the ones they feel that cannot do:

- Decide how they are different or similar to others they have done and share that information on their homework papers
- Include rules that might apply to a specific problem
- Give a written description of where in the process they become confused and why.

The next day in class the specific analyzed difficult problems, rather addressed. This will result in good understanding of the topic. Of use and patience on the part of the this format by writing analyses of Cooperative groups can work their thoughts with the class. Even

comments from students who have actually than having totally ignored them, will be class discussions and be the basis for a deeper course, such a plan takes modeling, consistent teacher. Students can have extra practice with incorrect answers on quizzes and tests. regularly on a problem together and then share though this strategy won't allow students to have

all the "correct answers" to the homework problems, it does provide them with thoughtful moments on each and affords them an opportunity to have done at least some work for all of the assignment. Perhaps students will come to realize that they actually know more than they thought they did, thus reducing anxiety and allowing them to complete an assignment.

We need to focus on the fact that, according to students, teachers--more than any group including parents--have a greater influence on their attitudes toward mathematics. Teachers must strive to make that influence a positive one. Initially, because students often mentioned the pace of the class as a critical issue in arousing anxiety, the math department needs to look at the scope of each course and honestly discuss the topics that are essential for the students' mathematical education. Limiting the number of topics discussed permits a slower pace and allows for expanded development and opportunities for hands-on activities. These activities are often mentioned as means to reducing stress in the classroom. Topics should be introduced in a manner that proceeds slowly from the concrete to the abstract. Teachers need to be more willing to share with students their unproductive attempts at solving problems. They need to see that problems can take time as well as several attempts. Teachers could model the methods they use to discover a better strategy. Students would find comfort in knowing that all problems are not easy, even for the teacher. Teachers need to demonstrate patience when they attempt challenging problems as well as when students themselves are struggling. Students need to feel that it is acceptable to make several attempts at one problem before arriving at an answer. Teachers can vary the styles of assessment they use in order to give the class an occasional opportunity to demonstrate their understanding in a way that compliments their learning styles. Evaluations could be achieved using a group test, assigning projects or portfolios, looking at journal entries or giving partial credit on traditional tests. Assessment can be more accurate when anxiety that usually accompanies tests is reduced in this manner.

Within the teachers' sphere of influence lie other strategies that will help students relieve the anxiety that is an acknowledged part of the mathematics classroom. They can be taught to work productively in cooperative groups that allow for shared responsibility. Students can be encouraged to read math textbooks with a pencil and paper at hand, working to understand how the examples are being done. Teachers can encourage students to draw diagrams of situations for better understanding, discuss math as they would a novel and use coping skills when they begin to get anxious.

Both students and adults realize that mathematics has a definitive place in their lives. They sense the urgency to understand the material, and that urgency often leads to anxiety when they cannot arrive at a solution. Perhaps more could be learned with less stress if everyone accepted the fact that, in mathematics as in many other analytical disciplines, the process is as important as the answer.

Answer for question 2 in the article "Two Problems for 2002."

<u>2002--Final Answer?</u>

Any six digit number of the form abcabc can be factored as

(abcabc) = (abc) x 1001 = (abc) x 7 x 11 x 13.

So the sequence of arithmetic operations yields the following results:

a.) (abcabc) / 11 = (abc) x 7 x13,
b.) (abc) x 7 x 13 x (abc) x 7 x 13 = (abc) x (abc) x 49 x 169,
c.) (abc) x (abc) x 49 x 169 / (abc) = (abc) x 49 x169,
d.) (abc) x 49 x169 / 13 = (abc) x 49 x 13,
e.) (abc) x 49 x 13 x 22 = (abc) x 2 x 49 x 11 x 13,
f.) (abc) x 2 x 49 x 11 x 13 / (abc) = 2 x 49 x 11 x 13,
g.) 2 x 49 x 11 x 13 / 7 = 2 x 7 x 11 x 13 = 2 x 1001 = 2002.